PAN-PACIFIC ENTOMOLOGIST
64(4), 1988, pp. 391–402

Trichogramma species in a chaparral community of southern California, with a description of a new species (Hymenoptera: Trichogrammatidae)

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Abstract.—Five species of *Trichogramma* were collected during a two year period in a chaparral community in southern California. Only *T. deion* Pinto and Oatman, and *T. funestum,* **sp. n.** were common. Both species occur together throughout the year but apparently are dominant in different habitats. *T. funestum* is described. It is most similar to *T. exiguum* Pinto and Platner, and *T. fuentesi* Torre.

Introduction

Our knowledge of *Trichogramma* systematics in North America primarily rests on collections from agricultural ecosystems. This is as expected considering the long-standing and widespread use of this genus of egg parasites in biological control (Ridgway et al., 1977). In an attempt to reverse this bias we have begun surveying a variety of natural areas, especially those adjacent to agriculture. By such efforts we hope not only to better estimate the taxonomic diversity of *Trichogramma* in North America but also to gain a better appreciation of intraspecific habitat diversity, a factor that should be considered when selecting agents for biological control.

Herein are reported results of a survey from 1985–1987 in a chaparral community in southern California. Although hundreds of collections in nearby agricultural areas have been made, this is the first effort at a site dominated by natural vegetation. Five species were collected but only two were common. One of these, *T. funestum,* is new and described below. The other species, *T. deion,* only recently described (Pinto et al., 1986), is the most commonly collected species in the western United States. Seasonal and habitat distribution of these two species within chaparral are reported here.

Methods

The sampling site is located in hills immediately west of Menifee Valley, ca. 10 km E. Lake Elsinore in SW Riverside Co. Most collections were restricted to an area of 2.0 hectares along a north-south running ridge (33°39′ N, 117°13′W; 550 m. el.). The few additional collections made elsewhere were within 1 km. of this site.

The study area is dominated by chaparral with a strong influence of Coastal Sage Scrub vegetation (see Munz, 1959 for characterization of these communities). As is typical of the low hills bordering the hot, dry interior valleys of southern California, perennial vegetation is relatively sparse. About 50% of the surface is covered by perennial canopy; the remainder is bare ground, much of it strewn with large granitic boulders. Dominant perennials at the site are *Salvia* spp. (primarily *S. mellifera*

Greene), *Eriogonum fasciculatum* Bentham, *Adenostoma fasciculatum* Hooker & Arnott, and *Ceanothus crassifolius* Torrey. Vegetation composition varies considerably with slope, slope exposure, and substrate. Contribution to total vegetation cover by the dominant perennials in areas sampled for *Trichogramma* is as follows: *Salvia* spp., 2–28%; *Eriogonum,* 14–21%; *Adenostoma* 2–18%, *Ceanothus* 1–4%.

The study site is bordered on all sides by vast areas of similar vegetation. Dwellings with small concentrations of domestic plants are scattered, but occur primarily to the east and west. Grain fields and greater human population density occur 2.5 km. W. of the site. A dwelling and a small irrigated vegetable garden (10 m. x 10 m.) surrounded by natural vegetation occur on the study site. Collections were made both in the garden and in natural vegetation at least 20 m. from all domestic plants. A collection was made once immediately adjacent to the garden on *Ceanothus.*

Almost all *Trichogramma* were collected by placing eggs of laboratory-reared *Trichoplusia ni* (Hübner) and *Plodia interpunctella* (Hübner) on vegetation (host egg traps). A few were taken in yellow-pan traps, sweeping vegetation, and by collecting naturally occurring Lepidoptera eggs. For host egg traps, eggs of both species were attached to individual strips of stiff index card (6.5 × 1.8 cm). Each card held approximately 150 *T. ni* eggs and 2500 *P. interpunctella* eggs. *T. ni* eggs were laid on paper towelling which was then cut into strips and glued to the index card with white glue. *Plodia* eggs were attached to the card with Scotch® double stick tape. Cards were clipped directly to vegetation. Eggs of *Trichoplusia* were irradiated with Cobalt 60 (12 krads for 5 min.) prior to use to prolong time of acceptability to *Trichogramma.* The *Plodia* eggs were not irradiated.

5169 cards were placed on various plants over 76 sampling dates (ca. every 1.5 wk) from 6 April 1985–19 May 1987, an average of 68 cards/sampling date. Cards were left in the field 1–2 da., depending on weather and levels of egg predation. Predation often could not be avoided. The use of Tanglefoot® around stems deterred ants and other crawling predators but did not preclude flying forms such as vespids, various Coleoptera and chrysopids. Predators rarely consumed all eggs on a given card, and often the few remaining eggs were parasitized by *Trichogramma.*

Egg cards were placed primarily on *Eriogonum, Adenostoma, Ceanothus* and garden plants (usually tomato or/and pepper). They were placed on *Eriogonum* and garden plants on almost every sampling date. *Adenostoma* and *Ceanothus* were used during time of bloom the first year but on almost every sampling date the second year of the study. Other plants sampled infrequently via egg cards were *Salix* sp. (twice), *Quercus agrifolia* Nee (4), *Lotus scoparius* (Nutt.) Otley (2), *Keckiella antirrinoides* (Benth.) (6), *Salvia mellifera* (3), and *Prunus ilicifolia* (Nutt.) Walp. (1).

A limited supply of laboratory-reared host eggs and relatively low parasitization rates by *Trichogramma* in the field prevented use of an adequate number of cards on all major perennials throughout the study. *Adenostoma, Eriogonum* and *Ceanothus* were chosen for extensive sampling because they were common in the area and are evergreen throughout the year. Several of the other plants (e.g. *Keckiella, Salvia mellifera*) are drought-deciduous and lack green foliage much of the time from May–November.

Limited numbers of laboratory eggs also resulted in some variation in the number of cards placed on particular plants on each date. For example, fewer egg cards were usually placed in the garden since they were more commonly parasitized than those on native plants. Uncontrollable levels of egg predation also necessitated placing more cards on certain plants at certain times of the year. The number of cards placed on plants on each date ranged from 7–20 on garden plants, 10–50 on *Eriogonum,* 8–40 on *Adenostoma,* and 9–20 on *Ceanothus.* The number of times each plant was sampled also varied considerably but all were sampled at least once during every month (Table 3). This variation precluded a quantitative treatment of much of the data but was allowed since we were attempting to maximize parasitization in a given habitat.

All plants sampled were in close proximity. However, egg cards were always attached to those that did not contact other species. Distances between species in sampling areas varied as follows *Ceanothus–Eriogonum,* 1–10 m.; *Adenostoma–Eriogonum,* 8–80 m.; *Ceanothus–Adenostoma,* 1–50 m. The garden was 1, 8 and 12 m. from the nearest *Ceanothus, Eriogonum* and *Adenostoma,* respectively.

Host trap cards were returned to the laboratory and held for observation. If one or more eggs on a card was parasitized (evidenced by its black appearance) the *Plodia* and/or *Trichoplusia* portion was isolated and placed in a vial with fresh host eggs. A sample of emerging adults was mounted from each collection. Most cultures were discontinued once the identity of the collection was determined. Although rarely occurring, parasitization of eggs of one of the hosts on a card by more than one species of *Trichogramma* was detected soon after emergence by obvious color and antennal differences.

Results

Five species of *Trichogramma* were collected (Table 1). *T. thalense* Pinto and Oatman, and *T. brevicapillum* Pinto and Platner were collected once in pan traps. *T. platneri* Nagakatti was taken from host trap eggs twice, once in the garden (on tomato) and once on *Keckiella. T. deion* Pinto and Oatman, and *T. funestum* were commonly collected from parasitized trap host eggs throughout the year, and both also were retrieved from sweep samples of natural vegetation. The latter two were the only species consistently parasitizing trap host eggs. Of the 5169 egg cards utilized, 409 (7.9%) were parasitized by either *T. deion* or *T. funestum. T. deion* also was reared from natural host eggs, *Manduca sexta* (L.) (Sphingidae) on tomato, *Pieris rapae* (L.) (Pieridae) on wild mustard, and *Plebejus acmon* (Westwood and Hewitson) (Lycaenidae) on *Lotus scoparius.* Natural hosts of *T. funestum* were not collected at the site. However, it has been recorded from eggs of *Vanessa cardui* (L.) (Nymphalidae) and *Plebejus emigdionis* (Grinnell) (Lycaenidae) at other locales (see below).

Although *T. deion* and *T. funestum* frequently were reared from trap eggs, the two apparently were not randomly distributed in the chaparral. *T. deion* was the only one to parasitize natural eggs and trap eggs in the garden; it also was more commonly retrieved from cards placed on *Eriogonum.* In comparison, *T. funestum* was commonly reared from cards placed on *Adenostoma* and *Ceanothus; T. deion* rarely was. The dramatic differences in habitat distribution in the chaparral is illustrated by comparing numbers of trap host cards parasitized by each species at the different positions (Table 2) and by the number of sampling dates/mo. each species was collected on each plant throughout the study (Table 3).

The association of *T. deion* and *T. funestum* on other plants in chaparral has not been adequately studied. However, limited additional host trap sampling on other plants retrieved both species from *Keckiella antirrhinoides; T. deion* from *Salix* sp.

Table 1. Species of *Trichogramma* in southern California chaparral and their method of collection.

Species	Method of Collection[1]			
	A	B	C	D
T. brevicapillum[2]	−	+	−	−
T. deion	+	+	+	+
T. platneri	+	−	−	−
T. funestum	+	−	+	−
T. thalense[3]	−	+	−	−

[1]A = Egg host trapping; B = Yellow pan traps; C = sweeping; D = reared from natural host eggs (see text).

[2]A single female collected V–8/15–1982.

[3]One male collected XII–1981 beneath canopy of *Quercus agrifolia.*

and *Prunus ilicifolia;* and *T. funestum* from *Quercus agrifolia.* Also, as already indicated, *T. deion* was taken from lycaenid eggs on *Lotus scoparius.*

Since eggs of *Trichoplusia* and *Plodia* were available on each card, relative host preferences by females of the two dominant *Trichogramma* species could be estimated. *T. funestum* more commonly parasitized *Plodia* [(on 66% of 145 cards parasitized $x^2 = 14.0$; $P < 0.01$)], whereas *T. deion* more commonly parasitized *Trichoplusia* (68% of 295 cards parasitized); $x^2 = 38.8$; $P < 0.01$. Laboratory rearings suggest that *T. funestum* is more successful on *Plodia. T. deion,* however, does well on both.

The percentage of cards parasitized by *T. deion* and *T. funestum* in 1986 is shown in Fig. 1. Percentages refer to cards parasitized per month. Data for garden plants and *Eriogonum* are separated for *T. deion* because parasitization in the garden was usually much higher. Percentages for *T. funestum* refer to cards placed on *Ceanoths* and *Adenostoma* since parasitization rates on both were similar. These data suggest that *Trichogramma* activity was highest from April–August, but continued at low levels in the winter and spring months. Although only *T. funestum* was retrieved from Oct.–Dec. in 1986, *T. deion* parasitized egg cards at low levels (1.7%–5.0%) on both *Eriogonum* and garden plants throughout this period in 1985. *T. deion* is more active on garden plants than on *Eriogonum.* Cards placed on the three native chaparral plants were less commonly parasitized than those on garden plants, except early and late in the year. These results must be considered tentative since the degree of acceptability of laboratory reared hosts relative to natural hosts is unknown, and indeed, may vary throughout the year as the quantity and species of natural hosts vary.

Discussion

T. deion and *T. funestum* were the only species collected commonly. *T. deion* is a common species in western North America in disturbed and natural habitats (Pinto et al., 1986). *T. funestum* was collected for the first time in this study and has since been taken at other sites in California (see below).

Both species occur together in chaparral throughout the year (Fig. 1, Table 3). Although occurring together, they apparently are not evenly distributed. *T. deion*

Table 2. Percentage of parasitized trap host egg cards parasitized by *T. deion* and *T. funestum* on three chaparral perennial shrubs and in an adjacent vegetable garden from April 1985–May 1987.

Trap host egg card placement			
Garden	*Eriogonum*	*Adenostoma*	*Ceanothus*
	Total number cards parasitized		
235	46	61	67
	% Parasitized by *T. deion*		
100.0%	93.5%	6.6%	10.4%
	% Parasitized by *T. funestum*		
0%	6.5%	93.4%	89.6%

was most commonly taken on *Eriogonum; T. funestum* was more frequent on *Ceanothus* and *Adenostoma. T. deion* also was abundant in the vegetable garden, far more so than it was on *Eriogonum. T. funestum* was never collected in the garden, even though this small plot of disturbed land was surrounded by chaparral and was within 5 m. of *Ceanothus* on which this species was collected. Both species parasitized trap eggs, but frequency of parasitization depended on the specific habitat (plants) the hosts were placed in. The absence of *T. funestum* from the garden plot correlates with our general experience collecting *Trichogramma* in California. Although the species is common in chaparral it never has been taken in the hundreds of parasitized eggs collected in agricultural and other disturbed areas at locales close to the study site.

Previous studies of *Trichogramma* have stressed the importance of habitat preference in partially explaining varying levels of parasitization on given host eggs (Flanders, 1937; Salt, 1935). Some studies implicate vertical stratification. For example, Thomas (1966), and Kemp and Simmons (1978) found *T. minutum* parasitizing more eggs of the spruce budworm (*Choristoneura fumiferana*) in the upper crown of balsam fir than in the lower crown. That levels of parasitism can be correlated with height is supported by Thorpe (1985), who showed that *T. pretiosum* and *T. minutum* had no obvious habitat preference within uncultivated and soybean fields, but that they did differentially parasitize eggs placed at varying heights.

Studies in crop systems by Norlund et al. (1984) showed that *Trichogramma* species were more common on *Heliothis* on tomato and beans than on corn. Further studies appear to explain these differences in distribution (Norlund et al., 1985a, b) showing that females of *T. pretiosum* responded to extract and to volatile synamones from tomato, whereas corn apparently does not possess the same attracting properties.

We have not conducted the studies to explain the differential distribution of *T. deion* and *T. funestum* in chaparral. Vertical stratification is a possible, but unlikely, explanation. *Ceanothus* and *Adenostoma* do represent higher habitats than either *Eriogonum* or garden plants. Yet egg cards were placed at varying heights on both *Adenostoma* and *Ceanothus,* levels which broadly overlapped those on *Eriogonum*

Table 3. Frequency of occurrence of *T. deion* and *T. funestum* in various vegetation components of chaparral as indicated by number of sampling dates per month each was collected[1] from 6 April 1985–19 May 1987.

	Plants sampled											
	Adenostoma			*Ceanothus*			*Eriogonum*			Garden[2]		
Month	*deion*	*funestum*	No. times sampled	*deion*	*funestum*	No. times sampled	*deion*	*funestum*	No. times sampled	*deion*	*funestum*	No. times sampled
Jan	0	1	2	2	2	6	2	1	4	2	0	6
Feb	0	2	2	0	1	5	0	0	4	2	0	5
Mar	0	2	4	0	1	3	0	0	4	0	0	3
Apr	1	8	8	1	3	3	1	0	3	2	0	5
May	0	1	9	2	2	3	4	1	9	3	0	7
Jun	1	1	3	0	2	3	3	0	7	3	0	7
Jul	0	0	3	0	2	3	3	0	6	6	0	8
Aug	0	0	2	0	1	2	2	0	5	5	0	5
Sep	0	0	1	1	0	2	0	0	5	3	0	6
Oct	0	1	1	0	0	1	1	0	5	1	0	5
Nov	0	0	2	0	0	2	1	0	6	1	0	6
Dec	0	1	2	0	0	4	1	1	6	1	0	5

[1]Based on parasitized laboratory-reared eggs (trap host cards).
[2]Usually only tomato and/or pepper plants sampled.

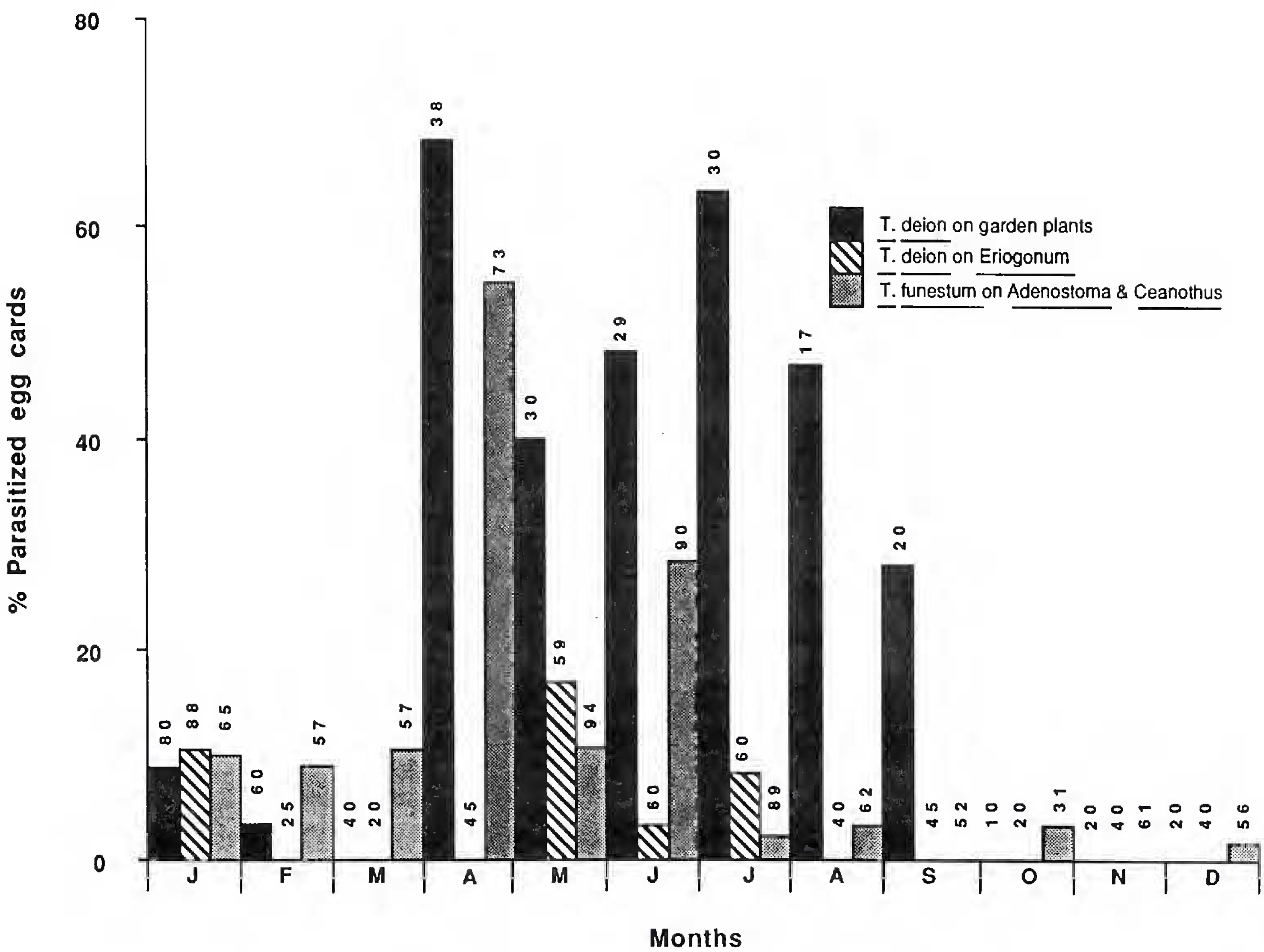

Fig. 1. Percentage of host egg trap cards parasitized per month by *T. deion* and *T. funestum* in various vegetation components of chaparral during 1986. Solid black = *T. deion* on garden plants; oblique lines = *T. deion* on *Eriogonum*; solid grey = *T. funestum* on *Adenostoma* and *Ceanothus*. Numbers above bars = total no. cards percentage is based on.

and garden plants. In fact, *T. funestum* was collected several times at positions on *Adenostoma* (less than 0.5 m.) which were as low or lower than sampling sites in the garden. More rigorous investigations of the possible effect of height are needed, however. The possibility that *T. deion* and *T. funestum* are initially attracted to plants of different height prior to host searching also should be investigated.

The differential distribution of both species possibly is dictated by natural host preferences. There is little value speculating on this possibility, considering our lack of knowledge of *Trichogramma* host preferences. That it is not an obvious explanation is suggested by the broad host range documented for *T. deion* (Pinto et al., 1986), and the common occurrence of the lycaenid, *Philotes battoides* (Behr), on *Eriogonum fasciculatum* (Emmell and Emmell, 1973), a plant rarely frequented by *T. funestum*. Although little host data are available for *T. funestum*, it has been collected from eggs of related lycaenids (see below).

Collections in this study were made in an area of considerable plant intermixture. All *Adenostoma* and *Ceanothus* sampled approximated *Eriogonum* plants and vice-versa; and all three plants grew near the garden plot. This proximity notwithstanding, *T. deion* and *T. funestum* overlapped minimally. Whether even this small degree of overlap occurs in the homogenous stands of *Adenostoma* and *Eriogonum* near the study site would be a logical follow-up study.

Three of the five species of *Trichogramma* collected in this study were rare. Their rarity may accurately reflect level of activity in chaparral or is attributable to the failure of our sampling methods to adequately sample all components of the plant community. Of the three rare species, *T. platneri* is the most common in southern California. It frequently is collected on Lepidoptera eggs on apple and avocado, and is commercially reared and released for biological control of these pests on avocado (Oatman and Platner, 1985). We also have collected it several times on codling moth eggs on apple (unpubl.). *T. brevicapillum* is abundant in parts of western United States but not in the southwest. In California, we have collected it only at three sites south of the San Bernardino Mts. North of there it is common. The third species, *T. thalense,* although rarely collected, is also known throughout much of western North America. Within California it has been taken primarily in the San Joaquin and Sacramento valleys. The single specimen collected in this study is the only record for southern California.

One of the surprising results of this study is the absence of *T. pretiosum.* A species parasitising a variety of hosts in disturbed habitats in California, we collect it commonly at sites within 10–20 km. from the study area (e.g. Lake Elsinore, Temecula, Perris). We noted in an earlier paper (Pinto et al., 1986) that *T. pretiosum* had never been taken in natural habitats in California. We were surprised, however, not to encounter it in the garden collections despite over 2 yrs. of host trapping and collecting naturally occurring eggs. The absence of appropriate host eggs is certainly not an explanation since *T. pretiosum* readily parasitizes eggs of the two laboratory-reared species utilized here, as well as eggs of *Vanessa* and *Manduca,* both of which occurred. Its absence apparently is explained by the isolation of the small garden within an area of primarily natural vegetation. *T. funestum* represents the opposite end of the spectrum regarding general habitat association. It is fairly common in chaparral but has never been collected in adjacent agricultural or other disturbed habitats. Unlike *T. pretiosum* and *T. funestum, T. deion* is much more plastic in habitat association. It is commonly collected in a variety of habitats throughout the western United States (Pinto et al., 1986).

Trichogramma funestum, New Species
(Figs. 2, 3)

Description based on P_1 and F_1 material from various collections at the type locality. Color data were taken from critical point dried F_2 culture material reared at 23–27°C on *T. ni* eggs and at ca. 50% RH. Quantitative data are based on 10 randomly selected P_1 specimens of each sex.

Terminology for genitalic structures below follows that used in earlier papers (e.g. Pinto and Oatman, 1985). A more detailed explanation of the formula for the basiconic capitate peg sensilla on the antenna was introducted in Pinto et. al. (1986).

Color sexually dimorphic. Female: thorax orange yellow except pronotum brown; head orange yellow above and in front, light brown to brown behind and below eye; gaster brown; legs and antenna light yellow. Male: as in female except mid-lobe of mesoscutum brown, concolorous to gaster. Length: 0.4–0.5 mm. Hind tibial length: averaging 0.158 ± 0.02 (0.13–0.18) mm. in both sexes (n = 20).

Male.—Antenna (Fig. 2). Flagellum moderately elongate, averaging 0.165 mm (0.14–0.20) long, slightly arcuate, 5.59 ± 0.37 (5.1–6.2) as long as wide, 1.05 ± 0.04 (1.0–1.1) as long as hind tibia; setae relatively short, stout, abruptly tapered at apex,

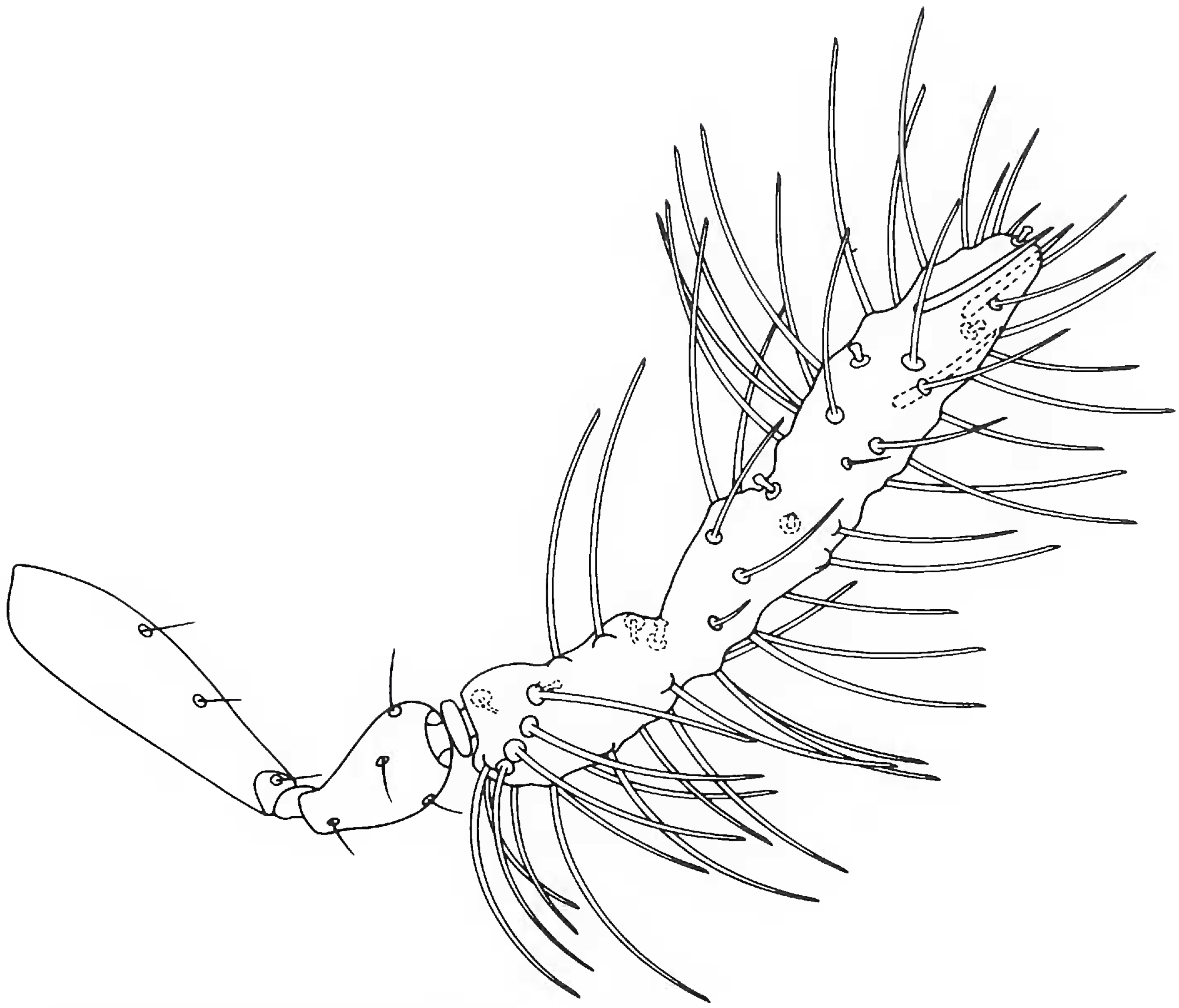

Fig. 2. *Trichogramma funestum:* Male right antenna.

longest seta 2.13 ± 0.12 (2.0–2.3) maximum width of flagellum, ca. 34–45 in number; formula for basiconic capitate peg sensilla (BCPS) = 1–1–2–1–1, infrequently with only 1 sensilla at third position. *Forewing.* Vein tracts well defined, moderate number of setae between tracts, 7–37 setae in area between 4th and 5th tracts; length of longest postapical seta on margin ca. 2× maximum width of hind tibia and 0.158 ± 0.03 (0.11–0.20) greatest wing width. *Hindwing.* Posterior vein tract with 5–7 setae, extending to ca. 1/2 the length of middle tract; anterior tract with 2 small setae *Mesoscutellum.* Anterior pair of setae short, ca. 1/4 the length of posterior pair. *Genital capsule* (Fig. 3). Moderately narrow, widest at base of dorsal expansion of gonobase (DEG), then evenly convergent to base and apex, sides straight, not distinctly sinuate near base of gonostyli (GS), 0.315 ± 0.01 (0.29–0.33) as wide as long, distance from apex of gonostyli to base of median ventral projection (MVP) composing 0.246 ± 0.01 (0.22–0.27) length of genital capsule; DEG subtriangular, only slightly notched at base, sides relatively straight to apex of posterior projection, not distinctly sinuate; apex of DEG attaining 0.886 ± 0.02 (0.85–0.92) length of genital capsule, usually attaining same level as MVP, but below apex of chelate structures (CS); MVP elongate, narrow, distinctly pointed apically, attaining 0.517 ± 0.06 (0.46–0.58) length of gonostyli; CS slightly to distinctly longer than MVP, attaining 0.689 ± 0.04 (0.62–0.75) length of GS; chitinized ridge (CR) distinct, relatively

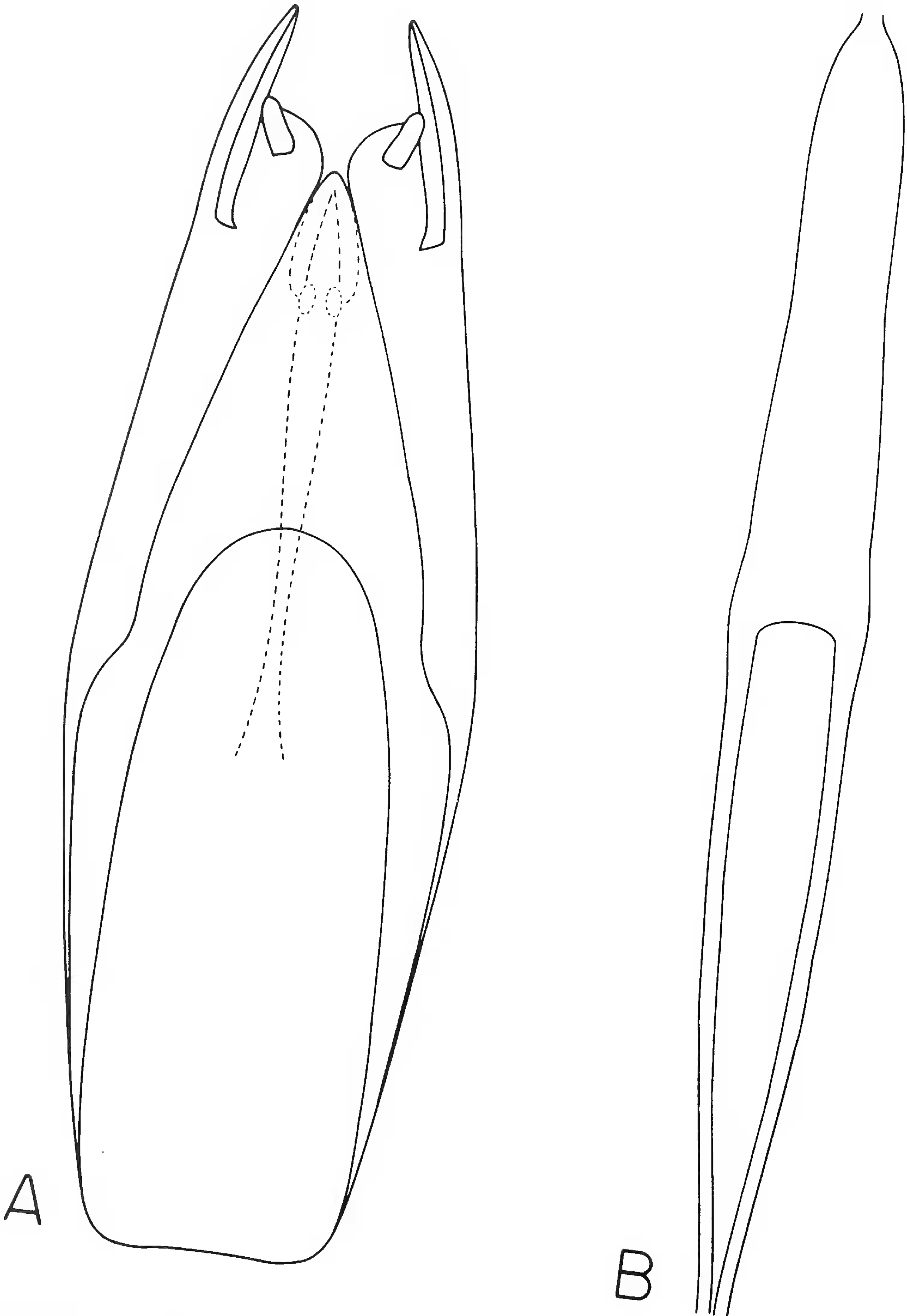

Fig. 3. *Trichogramma funestum:* A. Male genital capsule (dorsal view). B. Aedeagus.

elongate, extending 0.463 ± 0.03 (0.43–0.53) distance from MVP to base of genital capsule. *Aedeagus.* Usually slightly longer than genital capsule, 0.913 ± 0.04 (0.84–0.98) as long as hind tibia; apodemes comprising ca. 1/2 its total length.

Female.—Antenna. Funicle segments subquadrate; BCPS formula differing from male, 1–1–1–1–1, a single peg sensilla at apex of each funicle segment and three unpaired sensilla on club; four placoid sensilla and ca. 22 apicoventral setae arranged in 6 transverse rows. *Ovipositor.* 1.037 ± 0.05 (1.00–1.15) as long as hind tibia.

Etymology of specific name.—Latin: "causing death."

Types. Holotype ♂ and allotype ♀ from CALIFORNIA, Riverside Co., Menifee Valley, hills on W. end (33°39′ N, 117°13′ W; 550 m. el.). Types represent F_1 material; parentals reared from trap host eggs (*T. ni*) placed on *Ceanothus crassifolius*; 28 January 1986; J. D. Pinto, collr.; deposited in the collection of the National Museum of Natural History, Washington, D.C. Eight additional F_1 siblings designated as paratypes; deposited as follows: 1♂, 1♀, British Museum (Natural History); 1♂, 1♀, Canadian National Collection; 1♂, University of California, Berkeley; 2♂♂, 1♀, University of California, Riverside. All type material mounted on glass slides in Canada Balsam.

Geographic Distribution.—California from Glenn Co., S. to western Riverside Co.

Records and Hosts.—UNITED STATES. *California. Glenn Co.* Alder Springs, 16♂♂, 3 June 1987, trap host (*Plodia* on *Pinus*), J. Pinto. *Los Angeles Co.* Solemint, 1♂, 3 June 1982, ex. *Plebejus emigdionis* egg (Lycaenidae) on *Atriplex canescens,* G. Pratt. *Riverside Co.* Hemet, E. of at 4000′ el., 1♂, 30 June 1983, undetermined egg on *Adenostoma fasciculatum,* R. Velten. Menifee Valley, hills on W. end (33°39′ N, 117°13′ W; 550 m. el.), 168 ♂♂, 17 ♀♀, numerous dates 1985–87 (see above), trap host eggs (*Plodia* and *Trichoplusia*) on *Adenostoma fasciculatum, Ceanothus crassifolius, Quercus agrifolia,* and *Keckiella antirrhinoides,* J. Pinto. *San Bernardino Co.* Summit Valley (2 mi. E. Hwy. 15), 1♂, 7 May 1982, sweeping, J. Woolley. *Ventura Co.* Dome Springs Campground, Los Padres National Forest, 2♂♂, 7 June 1986, ex. *Plebejus emigdionis* egg on *Atriplex canescens,* G. Pratt. Dome Springs Campground, ca. 4 mi. SW on Lockwood Valley Rd., Los Padres National Forest, 4♂♂, 3 ♀♀, ex. *Plebejus emigdionis* eggs on *Atriplex canescens,* 10 May 1985, G. Pratt; ex. undetermined Geometridae eggs on *Atriplex canescens,* and *Vanessa cardui* egg on bush lupine, 22 May 1986, E. Oatman and J. Pinto.

Notes.—*T. funestum* is most similar to *T. exiguum* Pinto and Platner, and *T. fuentesi* Torre. These two species were recently treated by Pinto et al. (1983). In all three the flagellar setae of males are relatively short (length less than 2.5 the maximum width of flagellum) and stout, tapering noticeably at the apex only. *T. funestum* is separated from both by specifics of the genitalia. In the latter two the genital capsule is somewhat broader and more abruptly narrowed apically (Pinto et al., 1983: Figs. 1c, d). Also, the sides of the genital capsule are sinuate at the base of the gonostyli and the sides of the DEG also are distinctly sinuate. In *T. funestum* the sides of the genital capsule and the DEG are relatively straight (Fig. 3). *T. fuentesi* is further separated from *T. funestum* by its shorter CR and subequally long CS and MVP. *T. exiguum* is further separated by its lighter color (light yellow-brown abdomen) and BCPS formula of the male flagellum. In *T. funestum* the basal two positions have only a single basiconic peg sensilla. In *T. exiguum* there usually are two sensilla at each of the two basal positions.

T. fuentesi and *T. exiguum* are known from central and southeastern United States and are allopatric to *T. funestum*. However, a currently undescribed species, extremely close to *T. exiguum* is known in California and has been collected at one of the same locales as *T. funestum*. The latter is separated from this species by the same traits cited for *T. exiguum*.

A culture of *T. funestum* from the type locality successfully crossed with the sample from Adler Springs, Glenn Co., CA. It did not cross with *T. exiguum*.

Acknowledgments

Culture maintenance, specimen preparation and other laboratory assistance was provided by G. R. Platner and R. K. Velten. Collections of *T. funestum* from Lycaenidae eggs were made by G. Pratt, who also identified the lycaenid hosts. Figs. 2 and 3 were prepared by Linda Bobbitt.

This study was supported by Grant No. BSR-8415378 from the National Science Foundation (J.D.P., Principal Investigator).

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